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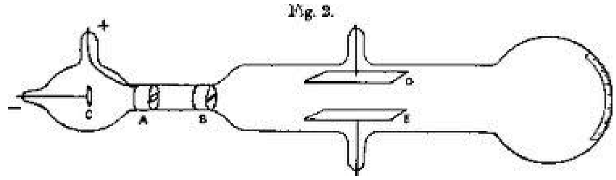
Atomic Structure Lab 2: Atomic Battleship

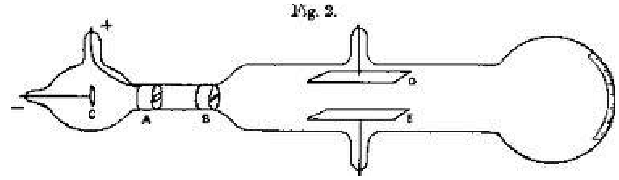
Your teacher will demonstrate the behavior of what were called cathode rays a hundred years ago. They were called cathode rays because they were emitted from the negative terminal, or cathode of what was known as a cathode ray tube, a forerunner of the television and the computer monitor tube.

Fig. 2.



What happens to the path of the cathode rays when horseshoe magnet is placed near the tube?

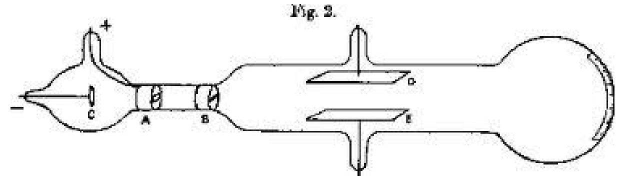
Fig. 2.



What do you think will happen to the path of the cathode ray when the orientation of the horseshoe magnet is reversed?

What happened?

Fig. 2.



Magnets exert a force on moving electrically charged particles. The effect of the magnet on the cathode rays therefore shows that these rays are moving electrically charged particles. Cathode rays, which have a negative electric charge, are made up of electrons. In 1897, Joseph John (J.J.) Thomson showed that identical rays (electrons) were emitted from the cathode of a cathode-ray tube, regardless of the metal of which the cathode was made.

Discovery of electrons emerging from the atoms of the cathode game scientists new information about the atom. The atom is not indivisible. It has internal parts, one of which is the electron.

In order to investigate the other components of an atom, you will take part in the following simulation, similar to the game *Battleship.* You will work with a partner for this activity. Below is a grid of squares, 8 by 10. Without letting your classmate see your grid, color in a section of ten squares. The squares must touch each other. To make the simulation relatively simple, begin with a fairly compact design. This shape represents your target.

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You and your partner will try to guess the shape of each other's targets by sending "missiles" onto any of the 80 squares in this array.

To begin, player A will tell player B the destination (number and letter) of the missile being sent. Player B will respond, indicating that the missile "hit" or "missed" the target shape. Player A will make not of the response. Then player B sends the next missile, nothing the response. Continue this process until one player identifies the other player's target.

Record the number of turns taken to complete the game.

	A	B	C	D	E	F	G	H	I	J
1										
2										
3										
4										
5										
6										
7										
8										

Number of turns: __________

Repeat the game with a target of only 2 adjacent squares. Record the number of turns taken.

	A	B	C	D	E	F	G	H	I	J
1										
2										
3										
4										
5										
6										
7										
8										

Number of turns: __________

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Now do a thought experiment. The same-size game grid is divided into smaller squares - 100 squares across and 100 squares down. There are now 10,000 squares in the same size board as before. A target of only one square is chosen.

> Record an estimate of how many turns will be required to identify the target square amongst the 10,000 squares in the game grid.

Now modify the thought experiment. The same-size game grid is now 1000 rows across and 1000 squares down. That is a total of 1,000,000 squares.

> Record an estimate of how many turns will be required to identify the target square amongst the 1,000,000 squares in the game grid.

An experiments similar to your game of "*Battleship*" was carried out in 1911 by Lord Ernest Rutherford. Rutherford sought to learn something about the structure of the atom by bombarding gold atoms with energetic particles given off by certain atoms.

In Rutherford's game of "*Battleship*," it seemed that he was required to send an incredible number of missiles to get a "hit." In terms of the battleship analogy, he concluded that the grid of the atom must be composed of tiny, tiny squares and only one square contains all of the positive charge of the atom.

> Explain why you you think he concluded this.